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MISCELLANEOUS.

Conducted by J. M. COLAW, Monterey, Va. All contributions to this department should be sent to him.

SOLUTIONS OF PROBLEMS.

40. Proposed by F. M. PRIEST, Mona House, St. Loufs, Missouri.

Suppose two cylindrical iron shafts, each 6 inches in diameter and respectively, 20 and 40 feet in height, are both standing perpendicular at the sea level. They start to fall in still air, how long will it require each one to fall to a horizontal position ?

Solution by G. B. M. ZERR, A. M., Ph. D., Texarkana, Arkansas-Texas.

Neglecting the atmosphere and supposing the cylinder to revolve about a diameter in the base, we get, if l is the length of an equivalent pendulum, from works on Mechanics the formula for the time of vibration of a pendulum,

$$t=\sqrt{\frac{l}{g}}\int_{\theta}^{a}\frac{d\theta}{\sqrt{\sin^2\tfrac{1}{2}a-\sin^2\tfrac{1}{2}\theta}}.$$

In this problem a is $180^\circ=\pi$, $\theta=90^\circ=\frac{1}{2}\pi$.

$$\therefore t=\sqrt{\frac{l}{g}}\int_{\frac{1}{2}\pi}^{\pi}\frac{d\theta}{\cos\frac{1}{2}\theta}=\left[2\sqrt{\frac{l}{g}}\log.\left\{\frac{\tan(\frac{1}{4}\pi+\frac{1}{4}a)}{\tan(\frac{1}{4}\pi+\frac{1}{4}\theta)}\right\}\right]_{\theta=\frac{1}{2}\pi}^{a=\pi}$$

$\therefore t=\infty$, which proves that in a perfectly vertical position they will not fall unless moved slightly from this position. Let $a=\pi-\delta$ where δ is very small.

$$\therefore t=2\sqrt{\frac{l}{g}}\log.\left\{\frac{\cot\frac{1}{4}\delta}{\tan 3\pi/8}\right\}.$$

Let $\delta=1'$, $l=$length of cylinder, $b=$radius of base.
$\therefore l=(3b^2+4l^2)/6l=13.3349$ feet for first cylinder.
$l=26.66745$ feet for second cylinder.
$\therefore t=2(.644328)(3.153498)=4.0638$ seconds for first cylinder.
$t=2(.911177)(3.153498)=5.7468$ seconds for second cylinder.

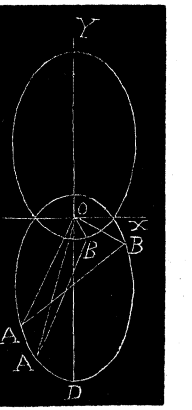
41. Proposed by WILLIAM SYMMONDS, A. M., Professor of Mathematics and Astronomy, Pacific College, Santa Rosa, California.

A straight inflexible bar of uniform weight and thickness, length m is suspended at the two ends by a string without weight, length $l>m$ passing freely over a peg driven in a perpendicular wall. Describe and analyze the curve traced on the wall by the ends of the hanging bar.

Solution by G. B. M. ZERR, A. M., Ph. D., Texarkana, Arkansas-Texas.

Let O be the peg, AB the rod. Let $OB=r$, $AO=r'$, $AB=m$, $\angle XOB=\theta$, $\angle XOA=\phi$.

Now in equilibrium OD always passes through the mid-point of AB.



Then $r+r'=1$ .....(1).

$m^2=r^2+r'^2-2rr'\cos(\phi-\theta)$ .....(2).

$r\cos\theta=r'\cos\phi$ .....(3).

(3) is obtained from the two triangles OAC, OBC.
(1) in (2) and (3) gives

$m^2=r^2+(1-r)^2-2r(l-r)\cos(\phi-\theta)$ .....(4).

$r\cos\theta=(1-r)\cos\phi$ .....(5).

(5) in (4) gives $l^2-m^2+2r^2\sin^2\theta-2rl=2r\sin\theta\sqrt{l^2-2rl+r^2\sin^2\theta}$.

$\therefore\ 4r^2(l^2-m^2\sin^2\theta)-4rl(l^2-m^2)+(l^2-m^2)^2=0.$

$$\therefore\ r=\frac{l^2-m^2}{2(l\pm m\sin\theta)}=\frac{l(1-e^2)}{2(1\pm e\sin\theta)},\ \text{where } e=m/l.$$

This equation represents two equal ellipses with eccentricity$=m/l$, major axis$=l$, minor axis$=\sqrt{l^2-m^2}$, and O is one focus of each ellipse.

[The above solves the problem—"An ellipse confined to one vertical plane is suspended from a fixed point in space, coincident with a movable point on its circumference. Describe the curve marked out by foci." EDITOR].

EDITORIALS.

With January, 1897, the Chicago *Open Court* celebrates its decennial anniversary and now appears in the form of a monthly instead of a weekly.

Plane and Solid Analytical Geometry, by Frederick H. Bailey, A. M., and Frederick S. Woods, Ph. D., Assistant Professors of Mathematics in Massachusetts Institute of Technology, is announced as ready in March by Ginn and Company.